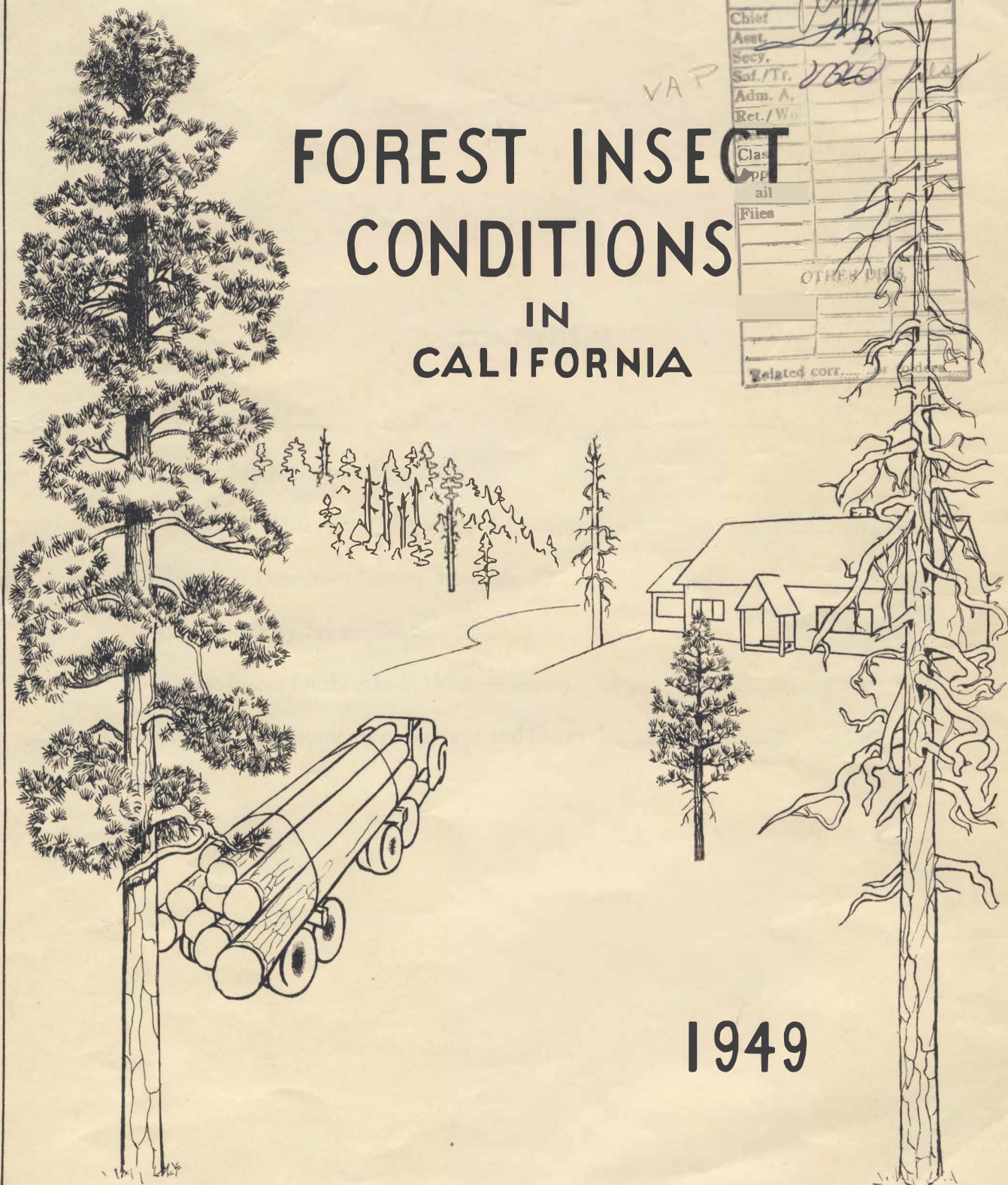


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FOREST INSECT CONDITIONS IN CALIFORNIA



1949

TIMBER MANAGEMENT
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STATE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FORESTRY

DeWITT NELSON
State Forester
SACRAMENTO

FOREST INSECT CONDITIONS IN CALIFORNIA*

SEASON OF 1949

INTRODUCTION

The volume of timber killed by forest insects in California during 1949 is greater than the loss sustained in 1948, although forest insect conditions throughout the State as a whole are still greatly improved over those of 10 to 20 years ago. The *Ips* engraver beetles have caused much less damage to pine this year than they have for several years past, but tree mortality as a result of attack by the *Dendroctonus* beetles has increased. In the fir types a general increase of damage by the fir engraver beetle, *Scolytus*, occurred in 1948 and has continued in 1949. The only serious defoliations in 1949 occurred in the oak types of the coast ranges, where the California oak worm and the tent caterpillar have been epidemic in local areas.

Among the factors responsible for the improvement in forest insect conditions during the past two decades are:

1. Seasons in which climatic conditions were favorable to the trees and unfavorable to the insects;
2. Increased control efforts by forest protection agencies in many parts of the State;
3. An increased amount of logging by selective methods to reduce the hazard of bark-beetle infestations and increase resistance in the pine stands.

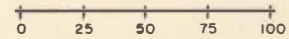
Current conditions and the areas needing special attention are indicated on the following map and table and are further described on pages 6 to 9 inclusive.

* This report prepared in cooperation with the Forest Insect Laboratory, U. S. Bureau of Entomology and Plant Quarantine, Berkeley, California. Entomologist in charge—F. P. Keen.

FOREST INSECT SURVEY

CALIFORNIA REGION

1949



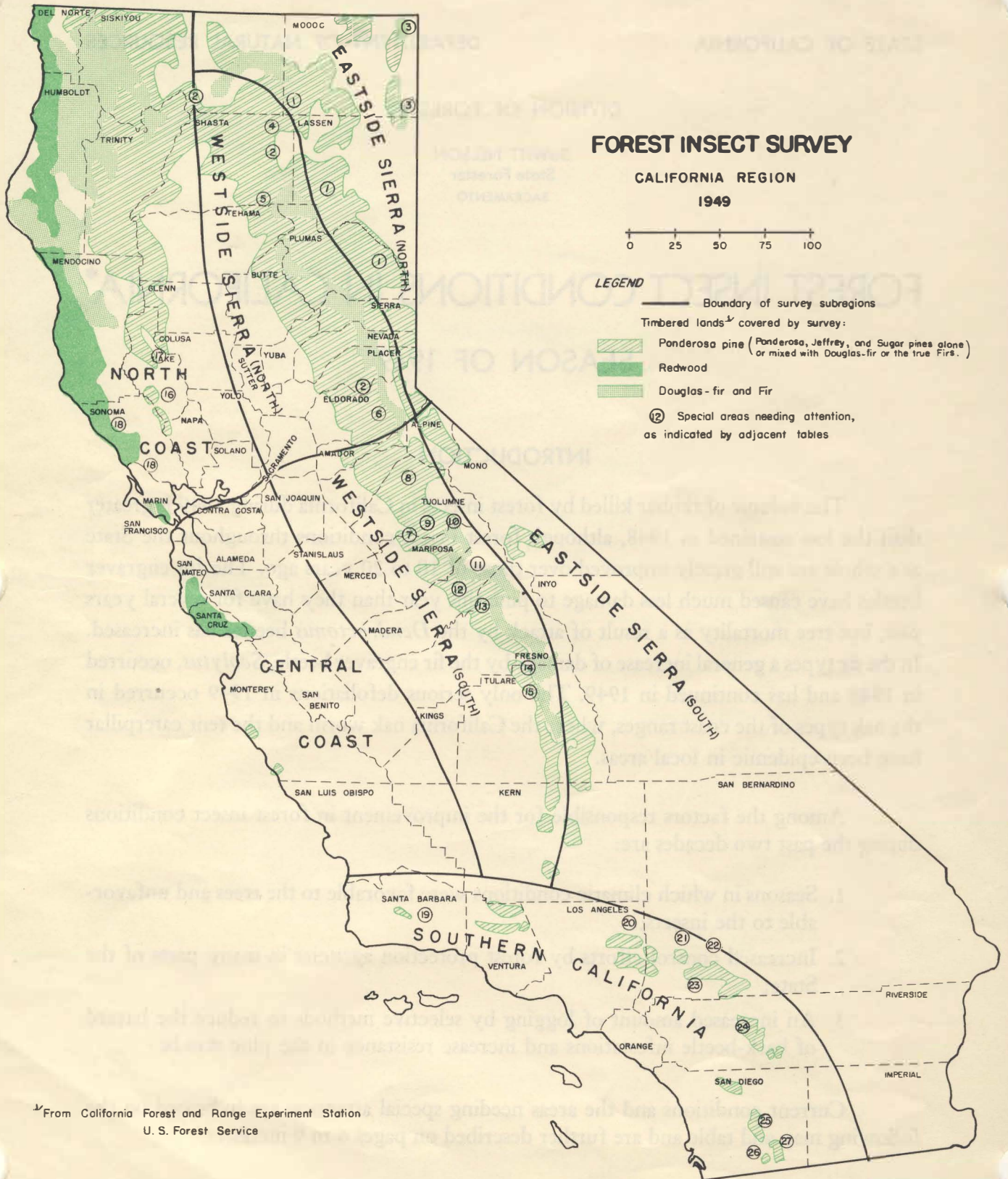
LEGEND

— Boundary of survey subregions

Timbered lands^{1/} covered by survey:

- Ponderosa pine (Ponderosa, Jeffrey, and Sugar pines alone or mixed with Douglas-fir or the true Fir.)
- Redwood
- Douglas-fir and Fir

② Special areas needing attention, as indicated by adjacent tables



^{1/}From California Forest and Range Experiment Station
U. S. Forest Service

SPECIAL AREAS REQUIRING ATTENTION

Name of Area	Location	Extent	Insect and Tree Species Involved	Status of Infestation	Recommended Action
1. Commercial pine areas.	Modoc, Lassen, Shasta, Siskiyou Cos. T. 23-48 N., R. 4 W.-17 E., M.D.M.	1,000,000 acres	Western pine beetle in ponderosa pine; Jeffrey pine beetle in Jeffrey pine.	Up Infestation increasing in fall of 1949. Seasonal loss from 50-100 b. m. per acre.	Sanitation-salvage control where feasible. Direct control in other areas of high values.
2. Shasta and Burney Brush-field plantations.	Shasta and Siskiyou Cos. T. 40 N., R. 4 W., M.D.M. T. 34 N., R. 3 E., M.D.M.	5,000 acres	Pine reproduction weevil in Jeffrey and ponderosa pine.	Down Infestation has been very light following spray control in 1947.	No control. Examination in 1950 for possible recovery of weevil infestation.
3. Warner Mountains.	Modoc Co. T. 38-48 N., R. 14-16 E., M.D.M.	10,000 acres	Spruce budworm on white fir.	STATIC Defoliation has persisted for a number of years. Very little tree mortality.	No control. Infestation should be watched for possible spread to more valuable fir stands.
4. Lassen Volcanic Park.	Shasta and Lassen Cos. T. 31 N., R. 4-6 E., M.D.M.	5,000 acres	Jeffrey pine beetle in Jeffrey pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel, and burn.
5. Viola Tract.	Tehama and Shasta Cos. T. 29-30 N., R. 2-3 E., M.D.M.	10,200 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	Up Increasing infestation in valuable timber.	Direct control, fell-peel-burn and salvage of infested trees in spring of 1950.
6. Cat Creek Area.	El Dorado Co. T. 12 N., R. 15 E., M.D.M.	2,500 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	Up Increasing infestation in valuable timber.	Direct control, fell-peel-burn and salvage of infested trees in 1950.
7. Wagner Ridge.	Mariposa Co. T. 2 S., R. 17 E., M.D.M.	3,500 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	Up Increasing infestation in marginal sites. Low timber values are involved.	Salvage of infested trees where feasible.
8. Pinecrest.	Tuolumne Co. T. 4 N., R. 18 E., M.D.M.	1,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn in recreational areas.
9. Yosemite National Park. Carl Inn Addition.	Tuolumne and Mariposa Cos. T. 1-2 S., R. 19 E., M.D.M.	10,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	Up Increasing infestation in recreational area.	Direct control, fell-peel-burn during spring of 1950. Maintenance control in Park.
10. Tenaya Lake. Yosemite National Park.	Mariposa Co. T. 1 S., R. 24 E., M.D.M.	1,000 acres	Lodgepole needle miner in lodgepole pine.	Up Increasing infestation in recreational area.	Experimental control in 1949. Additional control if infestation continues to increase.
11. Chiquito Creek.	Madera Co. T. 6 S., R. 24 E., M.D.M.	8,000 acres	Western pine beetle in ponderosa pine.	Up Increasing infestation but not yet epidemic.	Direct control, fell-peel-burn if increasing trend continues. Examine area in spring of 1950.
12. Bass Lake.	Madera Co. T. 7 S., R. 22 E., M.D.M.	5,000 acres	Western Pine beetle in ponderosa pine.	Up Infestation increasing in recreational area.	Maintenance control, fell-peel-burn in camp grounds and surrounding areas.
13. Fence Meadow.	Fresno Co. T. 11 S., R. 26 E., M.D.M.	7,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	Up Increasing infestation in sugar pine; valuable commercial timber is threatened.	Direct control, fell-peel-burn in spring of 1950.
14. Cedar Grove. Sequoia National Park.	Fresno Co. T. 13 S., R. 30 E., M.D.M.	1,500 acres	Western pine beetle in ponderosa pine.	Up Increasing infestation in recreational area.	Direct control, fell-peel-burn in spring of 1950.
15. Marble fork of Kaweah. Sequoia National Park.	Tulare Co. T. 15 S., R. 32 E., M.D.M.	5,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn in scenic areas.
16. Cobb Mountain.	Lake Co. T. 11-12 N., R. 8 W., M.D.M.	10,000 acres	Ips and western pine beetle in ponderosa pine.	Up Epidemic infestation as a result of snow-break slash during spring of 1949.	Direct control, fell-peel-burn in spring of 1950. Maintenance control needed.
17. Lucerne Area.	Lake Co. T. 15 N., R. 8 W., M.D.M.	5,000 acres	Ips and western pine beetle in ponderosa pine.	Up Epidemic outbreak as a result of Skyline fire in 1947. Infestation declining in fall.	Salvage of infested and recently abandoned trees.
18. Woodland Type.	Coast Range Counties T. 10-25 N., R. 10-17 W., M.D.M.	local areas	California oak worm; California tent caterpillar and deciduous oaks.	Up Epidemic centers have caused heavy defoliation and serious injury.	Spray control to protect trees on intensively used sites.
19. Figueroa Mountain.	Santa Barbara Co. T. 8 N., R. 30 W., S.B.M.	3,000 acres	Ips and western pine beetle in ponderosa and Coulter pines.	Up Epidemic infestation has reached the group killing stage.	Direct control, fell-peel-burn in spring of 1950, followed by maintenance.
20. Big Pines—Wrightwood.	Los Angeles and San Bernardino Cos. T. 7-8 N., R. 3-4 W., S.B.M.	5,000 acres	Pine flathead and Ips beetles in Jeffrey and ponderosa pines.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn.
21. Crestline—Lake Arrowhead.	San Bernardino Co. T. 2 N., R. 3-4 W., S.B.M.	15,000 acres	Ips and western pine beetle in ponderosa pine; Mountain pine beetle in sugar pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn.
22. Big Bear.	San Bernardino Co. T. 2 N., R. 1 E., 1 W., S.B.M.	8,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine; Jeffrey pine beetle in Jeffrey pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn.
23. Barton Flats.	San Bernardino Co. T. 1 N., R. 1 E., S.B.M.	1,000 acres	Mountain pine beetle in sugar pine; western pine beetle in ponderosa pine; Jeffrey pine beetle in Jeffrey pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn.
24. Idyllwild—San Jacinto.	Riverside Co. T. 5 S., R. 2-3 E., S.B.M.	10,000 acres	Western pine beetle in ponderosa and Coulter pine; mountain pine beetle in sugar pine; Jeffrey pine beetle in Jeffrey pine.	Up Infestation approaching epidemic.	Direct control, fell-peel-burn for entire area in spring of 1950. Maintenance control needed.
25. Julian—Cuyamaca.	San Diego Co. T. 13 S., R. 4 E., S.B.M.	20,000 acres	Ips and western pine beetle in ponderosa and Coulter pines.	Down Epidemic condition of 1947-1948 broken by control. A few active centers remain.	Direct control, fell-peel-burn and maintenance control during 1950.
26. Corte Madera.	San Diego Co. T. 16 S., R. 4 E., S.B.M.	800 acres	Ips and western pine beetle in Coulter pine; pine flatheads in Jeffrey pine.	STATIC Infestation remains endemic.	Maintenance control, fell-peel-burn.
27. Laguna Mountain.	San Diego Co. T. 15 S., R. 5 E., S.B.M.	10,000 acres	Pine flatheads in Jeffrey pines; western pine beetle in Coulter pine.	Up Sustained tree mortality due to complex of climatic factors, disease, and insects.	Maintenance control, fell-peel-burn in campgrounds, and summer home areas and experimental control to methods best adapted to this situation.



DETECTION SURVEYS LOCATE NEW CENTERS OF BARK-BEETLE ACTIVITY

This virgin pine forest in Plumas County shows the first signs of bark-beetle activity. Beetle-killed trees are easily spotted from the air as the red and sorrel foliage contrasts sharply with the green background of living pines.

Approximately 4,000,000 acres of California's forests were viewed by airplane during the detection survey program. Current timber loss resulting from insect attack is not severe, but many individual areas are in need of control to prevent epidemic outbreaks.



BARK-BEETLE OUTBREAKS OFTEN SPREAD FROM SMALL CENTERS OF ACTIVITY

During the season of 1930 small groups of ponderosa pines were attacked by Ips and the western pine beetle in the Cascadel Basin of the Sierra National Forest. This incipient outbreak was not controlled and by the end of the following season (1931) the infestation had reached the intensity shown in this photo. In this basin the loss of trees amounted to about 35 percent of the stand before the epidemic was brought under control.

Epidemic infestations can be prevented by early detection and prompt suppression.

THE REGIONAL DETECTION SURVEY PROGRAM FOR 1949

A fairly complete picture of forest insect conditions throughout California was obtained for this season through the use of both aerial and ground surveys. The general survey program was planned and directed by the Forest Insect Laboratory of the U. S. Bureau of Entomology and Plant Quarantine; federal, state, and private forest agencies participated in the project to the extent of providing information and facilities for examinations in a number of local areas.

Ground Surveys. The field work of the 1949 survey was started in July with two crews of three men each. The first phase of the project was a measurement of current losses in the commercial pine areas in Northeastern California for the purpose of obtaining reliable estimates of the insect-caused drain in timber stands. Early in September the appraisal of current infestations was begun in commercial mixed conifer types of the north coast subregion. This ground work, together with a later aerial reconnaissance, was the most comprehensive survey of insect conditions yet attempted in this part of the State. In addition to this detailed work by field parties, entomologists from the Forest Insect Laboratory contacted the field headquarters of the national forests, national parks, State Division of Forestry, and private timber companies in all subregions and made preliminary examinations of infestations reported by these agencies. It was in this phase of the survey that the cooperative effort of all organizations contributing to the survey was most effective.

Aerial Reconnaissance. The first aerial reconnaissance for this season was made on September 22d over the isolated islands of pine type in the interior of the Los Padres National Forest. Because of their inaccessibility several of these areas had never been previously examined for bark-beetle conditions; from this one mission estimates were obtained of fading and red-top trees, of tree species affected, and of the types of bark-beetle infestations in the areas covered. In late October the U. S. Forest Service made available one of its observation planes and the services of a pilot and observer for 12 days of flying on forest insect surveys. During this period all the important pine areas were covered from Northern California to the southern Sierras. Only the east slope of the Sierras from the Truckee River south was excluded from the air survey, mainly because of the very limited extent of pine type on this side of the mountains and the fact that most of it can be viewed from vantage points on the ground.

It was soon found that the greatest amount of data could be obtained with two observers in the plane, in addition to the pilot, and that the best elevation for spotting insect-killed trees was 500 to 1,000 feet above the forest canopy. Observers on most of the flights were entomologists from the Forest Insect Laboratory who were familiar with the areas flown, the insects responsible for the killing of trees, and the visual characteristics of the infestations that were seen from the air. Specific courses were mapped out in advance for each flight so as to bring under observation all of the important drainages and areas selected for reconnaissance.

Altogether, approximately 4,000,000 acres of forest types were covered by the air survey in 42 hours of flying. One significant result of this phase of the project was the detection of several new centers of infestation which had not been previously reported and had been missed in the ground reconnaissance. Where infestations of a serious character were located, the area was reflown and estimates obtained by running

sample strips in which the number of recently killed and infested trees were counted within a determined acreage. As a final check, further ground examination was made in those areas where control work was considered to make sure that the entomological situation had not been misinterpreted from the air.

Seasonal climatic variations must be taken into account in the appraisal of survey data, and it is possible that the final 1949 timber losses will turn out to be heavier than were estimated. It was necessary to terminate the field work of the survey early in November in order to present reports and recommendations to forest protection agencies in time to formulate plans for control work during the coming winter season; but a few field examinations made about the first of December indicate that the force of the late fall attacks will contribute to a heavier overwintering population of bark beetles than was indicated earlier in the season. Unseasonable warm weather during November of this year stimulated the development and attack of bark beetles; this may have changed some of the reported situations by the time winter closed in.

CONDITIONS BY SUBREGIONS

1. *Eastside Sierra Subregion—North (Northeastern California)*

The commercial stands of pine timber in Northeastern California long have been subjected to heavy killing by bark beetles, and over the course of the past 20 years heavy depletion of timber resources has taken place. Subsequent to the heavy epidemics of the western pine beetle during the period from 1931 to 1935, the annual tree mortality has been relatively low. This same low level of loss continued during 1948 and the first part of 1949, but by late fall of this season a rapidly accelerating rate of beetle attacks appeared in many areas.

1949 conditions noted:

1. *Western pine beetle—commercial pine areas.* In virgin pine stands the hazard of further beetle losses is high and late fall attacks indicate increasing infestations; salvage logging of infested and high-risk trees is recommended wherever feasible.
2. *Pine reproduction weevil—Brushfield plantings.* Aerial sprays in 1947 successfully reduced infestations in the Shasta and Burney plantings. The 1949 infestation is very light and does not require further spray control.
3. *Spruce budworm—Warner Mountains.* Defoliation has been persistent for a number of years in both the north and south Warner Mountains. Tree mortality is low and no large areas of fir are threatened at present.
4. *Needleminer (Recurvaria sp.)—Modoc National Forest.* There was a noticeable mining of needles on ponderosa pine around Crowder Flat. Damage to date is light, but this type of infestation may become widespread.
5. *Winter kill—ponderosa and Jeffrey pine.* This was noticeable in small trees on local exposed sites throughout the subregion following the severe winter of 1948-49. A few larger trees suffered killing in lower crowns. No evidence of insects breeding up in these cold-injured trees was shown.

II. Eastside Sierra Subregion—South (Mono and Inyo Counties)

Forest insect problems in this subregion have been limited to bark beetles in the restricted pine types, and are of concern mainly because of recreational uses of the area. A severe outbreak of the fir tussock moth, which killed about 35 percent of the white fir in areas south of Mono Lake from 1934 to 1938, has been quiescent in recent years.

1949 conditions noted:

1. *Bark beetles in pine stands.* Limited ground surveys indicated no serious infestations for this season.
2. *Needleminer (Recurvaria milleri) in lodgepole pine.* An infestation of long standing in Cowtract Meadow area still continued with little tree mortality.

III. Westside Sierra Subregions—North and South (From Tehama to Tulare Counties)

In past years, tree mortality caused by insects in the mixed conifer forests of the western slopes of the Sierras has been characterized by wide annual fluctuations. The heaviest losses have been caused by sudden epidemics, often local in scope, which die down within a few years. Between these sporadic epidemics there is a low annual drain of trees which are attacked because of weakening from drought, overmaturity, or injury.

For the season of 1949 the general trend of bark-beetle infestations was much the same in both northern and southern subregions. The most striking developments for the season were the subsidence of *Ips* outbreaks in the lower elevation pine type, and a noticeable increase of *Dendroctonus* infestations in many areas of the higher elevation mixed conifer type.

1949 conditions noted:

1. *Engraver beetles (Ips spp.) in ponderosa pine.* The killing of large groups of trees, which was prevalent from 1946 to 1948, has largely disappeared following the closing of numerous small sawmill operations in second growth and marginal timber. No direct control work is necessary but the prevention of future outbreaks by seasonal timing of cuttings and disposal of slash in which these beetles breed is a recommended control measure.
2. *Jeffrey pine beetle—Jeffrey pine.* The 1949 infestations were largely endemic. Maintenance control is recommended in parks, resort areas, and campgrounds.
3. *Western pine beetle—ponderosa pine.* An increasing infestation for this season occurred mostly in large mature trees, widely distributed, but with very little grouping of attacks. A number of areas of highly valuable commercial timber were noted in which losses will be formidable in another year if the present trend continues. These areas should be closely watched for developments in 1950 and direct control undertaken if conditions warrant. Maintenance control is recommended in any case in resort, summer home, campground areas, and in parks.

4. *Mountain pine beetle—sugar pine.* An increasing 1949 infestation of this beetle is characterized by initial top-killing of large, mature trees; this is followed by subsequent attack on the lower bole which kills the entire tree. In some areas this type of attack has reached the small group stage. Control either by direct or salvage methods should be considered. The most serious conditions were found in the Viola Tract, Tehama County; Cosumnes drainage, Amador County; Fence Meadow, Fresno County; and the Carl Inn Addition in the Yosemite National Park.
5. *Fir engraver beetle in fir types.* Increased top-killing of both white fir and red fir was noted in 1948, and this has continued through 1949 with considerable tree mortality. No thoroughly effective control method has been developed for this insect, but disposal of infested trees in intensively used areas is desirable as a sanitary measure.
6. *Lodgepole needleminer—Yosemite National Park.* An epidemic infestation found near Tenaya Lake threatens the remaining stands of living lodgepole pine in the Tuolumne and Merced watersheds. A control experiment applying DDT and BHC formulae by airplane was attempted in August 1949 under conditions unfavorable for flying. Only a limited area was covered, but on selected plots, high mortality of eggs and young larvae was secured with the BHC formula; fair results were obtained with DDT.

IV. North Coast Subregion

1949 conditions noted:

1. *Western pine beetle—Upper Lake District.* A heavy center of recent infestation north of Lucerne was disclosed by aerial reconnaissance; the 1949 loss was estimated at 230 board feet per acre on approximately 3,800 acres. This outbreak obviously originated in fire-injured trees surviving the Skyline fire of 1947, then spread to adjoining green timber in 1948-49. Ground surveys in late October indicated that the epidemic apparently reached its peak during the summer of 1949 and is now declining. Salvage of currently infested and recently abandoned trees is recommended.
2. *Oak defoliators.* Both live and deciduous oaks were heavily defoliated this season throughout the lower elevations of the Coast region by the California oak worm (*Phryganidia californica*) and the California tent caterpillar (*Malacosoma californica*). In some localities these infestations have persisted for several years, and trees which have been repeatedly defoliated are either dead or their recovery is doubtful. Epidemics of this character usually are controlled in time by natural agencies, but damage to trees during epidemic periods can be avoided if sprays are applied in time to prevent extensive feeding by the caterpillars.

V. Southern California Subregion

The forested areas in Southern California are limited in extent but are subjected to extremely heavy recreational use by the nearby large population centers. Each year hundreds of thousands of people spend their vacation time in resorts, playgrounds, and summer homes in the conifer types. Continual clearing and building activities have

served to aggravate the problem of keeping bark beetles under control. The value of the pine stands as shelter for these recreational activities cannot be overestimated, and in the most highly developed areas trees are indispensable. For many years the agencies concerned with protecting forest values in the mountain areas of Southern California have waged a continuous battle with bark-beetle infestations. The conditions found in 1949 emphasize the need for continued programs of maintenance control.

1949 conditions noted:

1. *San Bernardino mountain resort areas.* Bark-beetle infestations in the pine types were largely endemic in 1949, but continued maintenance work on the same scale and pattern as in previous years is needed in the Big Pines, Crestline, Lake Arrowhead, Big Bear, Barton Flats, and Idyllwild-San Jacinto districts. The heaviest infestations were found in the Idyllwild area where *Ips*, western pine beetle, and pine flatheads are active this season because of insufficient coverage of the infested area in the control program of 1948.
2. *Santa Barbara areas.* Bark-beetle infestations are on the increase in the isolated bodies of pine type in the interior of the Los Padres National Forest. In some areas the killing of pines in 1948-49 reached the group stage and can be considered epidemic. Control work is not feasible in a number of inaccessible areas but is recommended for Mount Figueroa to protect values in established summer home tracts.
3. *Mount Palomar.* Bark-beetle infestations in pine type are light, but an unusual top-killing of white fir by the fir engraver beetle occurred in the spring of 1949 in the Mendenhall Valley south of the observatory. No control is recommended, as the trouble appeared to be dying down when the survey was made in late October.
4. *Julian-Cuyamaca areas.* The 1949 kill of pines is light compared to that of preceding years. Intensive control work during the winter of 1948-49 and the spring of 1949 broke up the epidemic of *Ips* and western pine beetle which had been aggressive since 1948, killing thousands of trees. A few centers of infestation are still active, and a continued maintenance control program is needed to keep this situation in hand.
5. *Mount Laguna area.* The 1949 survey showed that the loss of Jeffrey pines continues at about the same level as in previous years. Regardless of a sustained program of maintenance control, the number of trees dying from flathead attack and other agencies averages more than two per acre. Entomological conditions in this area have presented the most baffling control problem yet encountered in the California region. Preliminary studies, interrupted by the last war, indicated that several species of insects, a root fungus, pathological conditions, and climatic factors were all involved in the high mortality of pines that has been going on for years. Plans for resumption of investigations and an experimental control project have been proposed to determine whether control is feasible under the conditions of this area.

ST INSECT OUTBREAKS IN NEIGHBORING WESTERN STATES

In the over-all picture of forest insect conditions in the western states for 1949, the greatest threat to forest resources exists in the tremendous outbreaks of the spruce budworm in the fir types of Oregon and Washington and the Engelmann spruce beetle in the spruce forests of Colorado. Approximately 2,500,000 acres of fir type in the Pacific Northwest are now involved in epidemics of the spruce budworm, and the damage ranges from light to nearly complete kill of white fir and Douglas fir stands. Forest protective agencies have acted promptly to bring this situation under control and plans are now under way to apply aerial sprays to nearly 1,000,000 acres of threatened timber. Some further control work may be necessary in 1951 to bring an end to this destructive outbreak of the budworm in western areas.

More than 4,000,000 board feet of timber have been destroyed by the Engelmann spruce beetle in the spruce forests of Colorado in recent years, and the entire spruce stands of the state are now threatened unless extensive control action is undertaken.

Other bark-beetle outbreaks of wide scope are that of the mountain pine beetle and the Black Hills beetle in the Rocky Mountain States and the Black Hills of South Dakota. Control operations during 1948 have largely checked the momentum of these epidemics.

RECENT DEVELOPMENTS IN FOREST INSECT SURVEYS AND CONTROL

Forest Pest Control Act Passed by Congress. An important new weapon in dealing with forest insect problems in California and other states is the Forest Pest Control Act, Public Law No. 110, passed by Congress in 1947. This act recognizes the responsibility of the Federal Government in initiating action and in cooperating with all types of ownerships for the control of insects and diseases which are destroying or threatening forest resources of the Nation.

The strategy behind the Forest Pest Control Act is the control of insect and disease outbreaks in their incipency before they have time to develop into widespread epidemics and cause vast destruction of forest resources. Obviously, the cheapest and most effective time to control insect outbreaks is while they are small. In order to implement such a policy it is essential that comprehensive detection surveys be maintained on an annual basis. Consequently, one of the first steps under the act was the appropriation of increased funds for detection surveys by the Federal Bureau of Entomology and Plant Quarantine, with the understanding that this service would be maintained for the benefit of all forest-owning agencies. The act also authorizes the Federal Government to initiate action and to use emergency funds for prompt control of outbreaks under agreements entered into with the states or owners of the affected timber. Such action is authorized wherever it can be shown that immediate control of pests is in the public interest. Operation of the act is fairly flexible as to cooperative agreements and assessments of costs. Individual ownerships are expected to bear their proportionate share of the costs except in cases where the local benefits of control are of little or no concern to the landowners. Funds to implement the act became available for the first time for the Fiscal Year 1950.

The California State Legislature recognized the importance of prompt control of forest insect outbreaks in 1945 when it revised the long existing but ineffective and inoperable Pine Beetle Control Law. Since 1945 the California Division of Forestry has had state funds at its disposal with which to help the private timber land owner on a fifty-fifty cost basis in the control of forest insects. Rarely is forest insect control an individual owner problem, but one calling for united and cooperative effort on the part of all affected timber owners, the State, and the Federal Government. The Forest Pest Control Act, Public Law No. 110, now makes it possible for the Federal Government to share with the State and the private owner the cost of forest insect control on timber lands in California. With this three-way cooperative program California is now assured a stable basis for a continuing program of forest insect control.

New Insecticides and Aerial Sprays. Control of forest insects received new impetus in recent years when new insecticides, such as DDT and BHC, became available in large quantities at moderate prices. When formulated and applied as finely atomized sprays by airplane, these insecticides can effectively control foliage-feeding insects with as little as one pound of insecticide in one gallon of spray per acre. Total costs of air application, including the price of insecticides, are surprisingly low and usually within the margin of \$2 per acre. With these new weapons it is now possible to attack widespread epidemics in difficult or inaccessible territory where control has previously been considered prohibitive because of the difficulties and high costs of applying sprays from the ground. In 1947 successful control of a tussock moth outbreak covering some 400,000 acres was accomplished in Idaho. A similar project of even greater magnitude is now being conducted against the spruce budworm in Oregon. Fortunately, at the present time California does not have any serious defoliating epidemics, but the availability of these new methods of chemical control should make it possible to promptly attack and check any new outbreaks that may appear before they become widespread. Control of bark beetles by aerial sprays is not possible as yet, for in all attempts thus far it has been found that these insects are too well insulated by the bark to permit effective action by contact insecticides when delivered by airborne equipment. However, recent results of insecticides applied by ground equipment hold promise as an effective and inexpensive control measure against certain bark beetle pests.

Control of Forest Insect Pests in California. With the single exception of the north coast redwood region in California, each segment of the diversified forest area in the State is plagued by one or more of the many species of insects which attack and kill trees. The intent and purpose of the annual forest insect survey in California is to detect early signs of insect-caused outbreaks so that prompt measures of control may be applied to suppress the insect populations and thereby prevent further killing of other trees.

The information presented in this publication is general in scope and intended to inform all land-managing agencies of current forest insect conditions and control programs throughout the State. More detailed information on the current status of tree-killing pests in all forested areas may be obtained by request from the State Forester or from the U. S. Bureau of Entomology and Plant Quarantine, Forest Insect Laboratory, 29 Forestry Building, University of California, Berkeley, California.